

## TITLE OF THE INVENTION

Powdering unit, powdering station and method for their operation

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## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

10 [0001] The invention relates to a powdering unit having a nozzle strip which produces a powder gas curtain containing powder particles distributed in a carrier gas stream, which curtain moves substantially in a curtain plane. It relates furthermore to a powdering station  
15 comprising two such powdering units. Furthermore, the invention relates to a method for operating a powdering unit and a powdering station.

### 2. Background Art

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[0002] Powdering units are used in the printing industry to spray the ink films of printed products which have not yet fully dried with a very fine powder (organic or inorganic) and thus prevent the printed products from  
25 sticking together via the ink layers when they are laid on top of one another to form a stack. In the event of blocking between successive printed products via the ink layers, the ink layers would be damaged on separating the individual printed sheets again, rendering the printed  
30 products unusable.

[0003] In the known powdering units, a powder gas produced in a separate generator and containing powder

particles suspended in a carrier gas stream is delivered via a nozzle strip having a multiplicity of nozzles of substantially the same orientation spaced apart in the longitudinal direction of the strip. The nozzle strip thus  
5 produces a powder curtain which is substantially homogeneous at a certain distance from the nozzle strip and through which the printed products to be sprayed with powder are moved with a conveying direction substantially perpendicular to the mean direction of the powder curtain.

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[0004] The powder curtain diverges substantially in a wedge shape from the nozzle strip. The mid-plane of this powder gas curtain is referred to hereinbelow and in the claims as curtain plane for short.

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[0005] In such powdering units, it is sought first of all to guide the powder curtain in such a way that as many as possible of the powder particles entrained in the carrier gas stream come into intimate contact with the ink  
20 layer of the printed product and adhere to the ink layer when and where the latter is still tacky.

[0006] By means of the present invention, a powdering unit having a nozzle strip which produces a powder gas  
25 curtain containing powder particles distributed in a carrier gas stream, which curtain moves substantially in a curtain plane, is to be developed in such a way that an even better adherence of the powder particles to the surface of the products to be sprayed with powder is  
30 ensured.

## SUMMARY OF THE INVENTION

[0007] This object is achieved according to the invention by means of a powdering unit having a nozzle  
5 strip which produces a powder gas curtain containing powder particles distributed in a carrier gas stream, which curtain moves substantially in a curtain plane, and wherein, the powder curtain moves between two angled guiding elements each having a first guiding side arranged  
10 parallel to each other or coplanar, and each having a second guiding side running parallel to the powder curtain plane.

[0008] In the powdering unit according to the invention,  
15 under use conditions, the first sides of the guiding elements form guiding walls which run at a distance from and parallel to the conveying surface of the products to be sprayed with powder. This ensures that the powder gas stream is held together over a certain distance of the  
20 conveying path of the products, in the direction perpendicular to the product-conveying direction. As a result, the powder particles have a longer opportunity to settle on the product surface.

25 [0009] Furthermore, the second sides of the guiding elements form a laterally delimited guiding channel which extends from the nozzle strip into the vicinity of the product-conveying plane. Consequently, the powder gas stream is also laterally held together on its way from the  
30 nozzle strip to the product surface.

[0010] The two guiding elements at the same time have the effect that less unused powder results, and in

particular that such unused powder does not collect at places adjacent to the nozzle strip of the printing machine in which the powdering unit is arranged.

5 [0011] Advantageous developments of the invention are specified in further preferred embodiments.

[0012] In particular, in one preferred embodiment, wherein the second sides form an angle differing from  $90^\circ$   
10 with the first sides, it is possible to give the incoming powder gas stream guided between the second guiding sides a velocity component in the conveying direction of the products, depending on the setting of the second guiding sides in, or counter to, the product-conveying direction.  
15 This too is advantageous with regard to achieving as high an adherence rate of the powder particles as possible. It is also possible to use the setting angle of the second guiding sides to influence the proportions of the powder gas stream which are guided, respectively, in the conveying  
20 direction of the products and counter to the product-conveying direction, along the product surface.

[0013] In another preferred embodiment, the end of at least one of the second guiding sides which is remote from  
25 the first side is connected to a carrying side which is perpendicular to this second guiding side and on which the nozzle strip is mounted. In such an embodiment, an alignment of the curtain plane and guiding channel which is formed by the second guiding sides of the guiding elements  
30 is obtained in a simple manner.

[0014] In another preferred embodiment, the corresponding guiding elements are closed, box-shaped

structures, which is advantageous with regard to keeping the guiding elements clean.

[0015] In yet another preferred embodiment, the box-shaped guiding elements can be additionally used to suck off excess powder gas in a controlled manner, so that it does not escape into the interior of the printing machine.

[0016] In such an embodiment described above, the suction slot is adjacent to the free end of the first guiding side. In another such embodiment, the second box-shaped guiding element is connected to a suction fan and its first guiding side delimits a suction slot. In one such embodiment, the suction slot is adjacent to that end of the first guiding side which is remote from the second guiding side. With any such embodiment, a long time of action of the powder gas on the product surface is obtained in this way.

[0017] In another embodiment, a substantially coplanar extension is provided for the first guiding side of at least one of the guiding elements. With such a development of the invention, the effect achieved is that a laminar blocking air stream is moved respectively from the downstream and upstream side of the guiding elements to the suction slots. Such a stream directed parallel to the product surface blocks the escape of unused powder gas particularly effectively and at the same time detaches only a few powder particles which have previously settled on the product surface.

[0018] In another preferred embodiment, a lead-in sloping surface is provided at that end of the first

guiding side of at least the upstream guiding element which is remote from the second guiding side. Such a development makes it possible to choose a relatively small distance between the first guiding sides of the guiding elements and  
5 the product-conveying plane and nevertheless to ensure that the leading edges of the printed products do not strike against the powdering unit.

[0019] In another preferred embodiment, a housing  
10 surrounding guiding elements and the nozzle strip. Such a development is advantageous with regard to achieving a smooth-surfaced exterior of the powdering unit and to keeping clean the interior of the printing machine in which the powdering unit is arranged.

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[0020] In a preferred embodiment, the powdering station may include two powdering units which are arranged on opposite sides of a conveying plane for products to be sprayed with powder. Using such a powdering station, the  
20 powdering of fresh printed products on both sides can be accomplished. This gives greater reliability of good re-separation of a printed sheet from a stack, since between two superposed printed products there are two powder layers, one on the bottom side of the printed product above  
25 and one on the top side of the printed product below.

[0021] An influence, due to the flow of air, on the conveyance of the products to be sprayed with powder is also brought about by a powdering unit. Wherein the two  
30 powdering units are substantially aligned with each other as seen in the conveying direction of the products, the effect achieved is that these influences are symmetrical

from both sides of the product-conveying plane, so that they are accentuated at least to some extent.

[0022] In one such preferred embodiment, the two guiding  
5 sides of the powdering unit cooperate with the bottom side of the products to be sprayed with powder are at a greater inclination with respect to the normal of the product-conveying plane than the second guiding side of the powdering unit cooperating with the top side of the  
10 products. With such an arrangement, the effect achieved is that one nozzle strip (in practice the one remote from the path of the grippers pulling along the products) can move somewhat closer to the product-conveying plane. Consequently, for this powdering unit, an even better  
15 powdering result is obtained.

[0023] If a powdering unit or a powdering station is operated wherein the air quantity drawn off via the guiding elements in the form of boxes is about 10 to 40 times,  
20 preferably 20 to 30 times, that of the powder gas quantity delivered by the nozzle strip, on the one hand a good blocking action against escape of powder gas is achieved, and on the other hand the extent to which powder particles which have already settled on the products to be sprayed  
25 with powder are blown off again is small at worst.

[0024] In one embodiment, the air quantities drawn off by the guiding elements are adjustable at least to some extent. With such an embodiment, undesired design-related  
30 dissymmetries in the flow conditions of the various guiding elements can be eliminated or conversely such flow differences can if desired also be produced if the

geometric conditions of the various guiding elements are the same.



## BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The invention is explained in more detail below  
using exemplary embodiments with reference to the drawing,  
5 in which:

[0026] Figure 1 shows a lateral schematic view of the  
delivery station of a printing machine having a  
powdering station for the substantially  
10 symmetrical powdering of the top side and bottom  
side of freshly printed sheets;

[0027] Figure 2 shows a similar view to Figure 1, in  
which a modified simplified powdering station is  
15 illustrated;

[0028] Figure 3 shows a similar view to Figure 2, in  
which a further simplified powdering station is  
shown; and  
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[0029] Figure 4 shows a similar view to Figure 3, in  
which the arrangement is further simplified and  
the two powdering units for the top side and  
bottom side of the printed sheets are offset from  
25 each other in the product-conveying direction.

## DETAIL DESCRIPTION OF THE DRAWINGS

[0030] While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and  
5 described herein in detail a specific embodiment with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiment illustrated.

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[0031] In Figure 1 the delivery station of a printing machine is depicted highly schematically. To the right of Figure 1, the various printing stations of the printing machine can be envisaged.

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[0032] The delivery station has two spaced-apart side plates 10, which are connected to each other by crossmembers (not shown specifically) and support two shafts 12, 14. The shafts 12, 14 carry chain wheels 16, 18  
20 which cooperate with closed chains 20. The latter carry at regular spacings grippers 22, only a few of which are indicated by way of example. The two ends of the grippers 22 are connected to aligned places of the two chains 20 and move on a closed path, as can be seen from Figure 1.

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[0033] Starting from the lower chain wheels 16, the chains 20 pass through a rising path section 24, then a path section 26 curving to the left, a horizontal path section 28, where the printed sheets are dropped and,  
30 falling one on top of the other, form a stack, and then run around the upper chain wheels 18. A return strand of the chains 20, which is denoted as a whole by 30, returns,

substantially parallel to the path sections 24, 26 and 28,  
to the lower chain wheels 16.

[0034] To guide the chains 20 in the path section 26 and  
5 the section of the return strand 30 parallel thereto, a  
plurality of free-running guide wheels or curved guide  
rails are provided, as known per se, these not being  
depicted in the drawing.

10 [0035] Provided in the region of the rising path section  
24 is a powdering station, denoted as a whole by 32. The  
latter comprises an upper powdering unit 34 lying above the  
product-conveying plane and a lower powdering unit 36  
substantially symmetrical to the upper powdering unit with  
15 respect to the product-conveying plane.

[0036] The reference symbols used in the following part  
of the description are entered partly at the powdering unit  
34 and partly at the powdering unit 36, for the sake of  
20 clarity of the drawing. It is understood that these  
reference symbols apply equally to the components, lying  
symmetrically with respect to the product-conveying  
surface, of the other powdering unit respectively.

25 [0037] As shown in the detail view of Figure 1, the  
upper powdering unit 34 comprises a downstream guiding box  
38 and an upstream guiding box 40.

[0038] The guiding box 38 is a prismatic sheet-metal  
30 part which is closed at its longitudinal ends by end walls  
42.

[0039] The peripheral wall of the guiding box 40 comprises a first guiding side 44 which runs parallel above the product-conveying surface. Adjoining the first guiding side 44 is a second guiding side 46, which forms an angle of about 95 to 100° with the first guiding side 44.

[0040] Adjoining the second guiding side 46 is a carrying side 48 which runs perpendicularly to the upper end of the second guiding side 46. That end of the carrying side 48 lying at the top in Figure 1 is led back into the vicinity of the free end of the first guiding side 44 via an outer side 50 running perpendicularly to the product-conveying surface.

[0041] The free, upper end of the first guiding side 44 is folded inwards by 90°, so that between the lower end of the outer side 38 and the inwardly folded end section of the first guiding side 44 a suction slot 52 is delimited.

[0042] Adjoining the lower end of the outer side 38 is an extension arm 54 which lies in the same plane as the first guiding side 44.

[0043] The sides 44, 46, 48, 50 and the arm 54 can in practice be formed by a single appropriately bent sheet-metal part, and the prismatically tubular body thereby formed is closed at its ends by the end walls 42 to form a box, as already mentioned above.

[0044] The upstream guiding box 40 comprises a first guiding side 56 which runs parallel to the product-conveying surface and lies in the same plane as the first guiding side 44 of the first guiding box 38.

[0045]     Adjoining the upper end of the first guiding side 56 is a second guiding side 58 which forms an angle of 85-80° with the plane of the first guiding side 56 and runs  
5 parallel to the second guiding side 46 of the first guiding box 38. The upper end of the second guiding side 58 is aligned with the upper end of the second guiding side 46.

[0046]     From the upper free end of the second guiding  
10 side 58 there extends parallel to the product-conveying surface an upper covering side 60, and adjoining the lower free end of the latter is an outer side 62 which leads substantially back to the free, lower end of the first guiding side 44. An end section of the first guiding side  
15 56 is again folded inwards by 90°, so that between the first guiding side 56 and the outer side 62 a suction slot 64 is delimited.

[0047]     Adjoining the outer side 62 is an extension arm  
20 66 which runs parallel to the product-conveying surface and is coplanar with the first guiding side 56. The extension arm 66 has at its free end an obliquely outwardly running lead-in section 68.

25 [0048]     The tubularly prismatic body formed by the sides 56, 58, 60 and 62 is again closed at its ends by end walls 70 and thus forms a closed box.

[0049]     Arranged on the carrying side 48 of the first  
30 guiding box 38 is a nozzle strip, denoted as a whole by 72. The latter comprises a distribution channel 74 which has a rectangular cross-section and one side face of which constitutes an extension of the second guiding side 46.

Seated on this side face of the distribution channel 74 in a manner spaced apart evenly perpendicularly to the plane of the drawing of Figure 1 are nozzle heads 76, the nozzle openings of which run perpendicularly to the head axis and  
5 are all oriented parallel, perpendicularly to the mounting surface of the distribution channel 74.

[0050] The spacing between the two guiding boxes 38 and 40 is chosen such that the plane defined by the axes of the  
10 nozzle heads 76 lies midway between the two guiding sides 46 and 58.

[0051] The interior of the guiding boxes 38, 40 is connected via separate pressure-regulating valves 78, 80  
15 (or flow regulators) to a suction machine 82, indicated merely schematically. The interior of the distribution channel 74 is connected to a schematically illustrated powder gas source 84 which produces a powder gas stream containing very fine powder particles suspended in a  
20 carrier gas. The powder particles may be lime or maize particles and may have a diameter of the order of 1  $\mu\text{m}$ .

[0052] The second powdering unit 36, which lies below the product-conveying plane, has substantially the same  
25 construction as described above for the powdering unit 34. There is thus no need to describe it again in great detail.

[0053] In the powdering unit 36, no extension arms are formed on the outer sides 50, 62, but rather the outer  
30 sides 50, 62 are joined to the ends of two sheet-guiding plates 86, 88 which extend over the lower part of the path section 24 and the path section 26, respectively.

[0054] The above-described powdering station works as follows:

[0055] The nozzle strips 72 are supplied with a powder  
5 gas stream from the powder gas source 84. From the nozzle  
heads 76 there emerge powder gas jets which overlap at the  
latest at the lower end of the guiding sides 44, 46 and  
form a powder curtain, denoted as a whole by 90 in the  
drawing. The curtain plane defined by the axes of the  
10 nozzle heads 76 is indicated at 92.

[0056] If a printed product is in front of the powdering  
units 34, 36, a first part of the powder curtain 90 flows  
upwards between the first guiding side 44 and the top side  
15 of the product (or for the powdering unit 36: the bottom  
side of the product). In the process, the powder particles  
suspended in the powder gas stream come into contact with  
the product surface and adhere to it, as long as the ink  
film is still tacky.

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[0057] Since the interior of the guiding boxes 38 is  
subjected to negative pressure, on the one hand air is  
sucked in through the suction slot 52 from that space which  
lies between the extension arm 54 and the top side of the  
25 product (or the rear side of the product). This air stream  
blocks the passage between the extension arm 54 and the top  
side of the product (or the rear side of the product) for  
the powder gas stream. The powder gas stream arriving at  
the upper end of the rising guiding shaft formed by the  
30 first guiding side 44 and the top side of the product (or  
the rear side of the product) is sucked in via the suction  
slot 52.

[0058] Correspondingly, the second part of the powder gas stream flows from the lower end of the supply guiding shaft, which is delimited by the second guiding sides 46, 58, through a falling guiding shaft, which is delimited by the first guiding side 56 and the top side of the product (or the rear side of the product), along the top side (or rear side) of the printed products, where powder particles are deposited.

10 [0059] As explained above for the powdering unit 34, between the extension arm 66 and the top side of the product (or the upper end of the sheet-guiding plate 86 and the rear side of the product) a blocking air stream is sucked into the outlet slot 64. Excess powder gas is thus  
15 sucked off via the interior of the guiding box 40.

[0060] It will be appreciated that, through the size of the angle at which the second guiding sides 46, 58 are tilted away from a direction perpendicular to the product-conveying plane, it is possible to adjust the proportions  
20 of the powder gas stream which run, respectively in the product-conveying direction and counter to the product-conveying direction, along the surface of the printed product until they are sucked off via the suction slots 52,  
25 64 of the guiding boxes 38, 40.

[0061] In Figures 2 to 4, details which are not necessary to explain the differences of these exemplary embodiments from the exemplary embodiment according to  
30 Figure 1 are omitted for simplicity.

[0062] The exemplary embodiment according to Figure 2 differs from that according to Figure 1 in that the second



guiding box 40 is not designed as a suction box. Furthermore, the lead-in section 68 is replaced simply by a sloping surface 68' at the upstream end of the guiding box 40. The latter no longer has an extension arm 66.

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[0063] In the exemplary embodiment according to Figure 3, the setting angle of the second guiding side 46 for the lower powdering unit 36 is at a greater inclination perpendicularly to the product-conveying surface.

10 Consequently, the nozzle strip 72 of the lower powdering unit 36 is arranged closer, which is made possible by the fact that the grippers holding the printed sheets do not get in the way at that point, while maintaining the same distance from the point of impact of the powder curtain 90  
15 on the printed product but achieving a greater glancing incidence.

[0064] The guiding side 46 is now also no longer a delimiting wall of the guiding box 38 but is attached to  
20 the latter. The lower nozzle strip 72 is fastened to the upper end of the second guiding side 46, as a result of which the correct alignment with respect to the curtain plane 92 for the rectangular cross-sectional shape of the distribution channel 74 is likewise ensured.

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[0065] The upstream guiding box 40 of the lower powdering unit 36 is designed with a triangular profile for its peripheral wall.

30 [0066] The upper powdering unit 34 corresponds to that according to Figure 2.

[0067] In Figure 3, a smooth-surfaced cuboid-like housing is indicated at 94 by dashed lines in each case, which housing surrounds the guiding boxes and the nozzle strip of a powdering unit.

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[0068] In the exemplary embodiment according to Figure 4, both powdering units 34, 36 are of similar design to that described for the lower powdering unit 36 of Figure 3. The inclination of the second guiding sides 46, 58 is, however, now again chosen to be the same for both powdering units 34, 36 and is respectively 95-100° and 85-80°, as described above.

[0069] The arrangement according to Figure 4 has the advantage that the powdering of the bottom side of the printed products takes place at a later time, so that the powder has less opportunity to fall off under gravity before the dropping of the printed sheet, which takes place in the horizontal path section 28. In addition, the deposited powder can be somewhat pressed against the bottom side of the printed sheets and thus adhere better when the bottom side of the printed sheets runs over a braking roller (sheet brake) 94, indicated schematically in Figure 4.

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[0070] Hereinabove, the powdering units have been described in connection with the rising delivery section of a printing machine. As can be readily inferred from Figure 4, however, the powdering units can also be arranged on curved conveying-path regions for the printed sheets, in particular also in transfer regions between cylinders and rollers close to the outlet of printing units.

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[0071]     Hereinabove, the powdering units and powdering stations have been described with reference to use in a printing machine. It goes without saying that the powdering units and powdering stations can also be used in other  
5 machines in which it is desired to render a tacky product surface non-tacky or to facilitate re-separation of stacked products. Corresponding applications are found in the production of plastic films but also in the production of glass products.

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[0072]     The foregoing description merely explains and illustrates the invention and the invention is not limited thereto except insofar as the appended claims are so limited, as those skilled in the art who have the  
15 disclosure before them will be able to make modifications without departing from the scope of the invention.